VI.1 Hydrogen Codes and Standards

Jim Ohi (Primary Contact), Russ Hewett, Lynnae Boyd, Roland Pitts
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401
Phone: (303) 275-3706; Fax: (303) 275-2905; E-mail: jim_ohi@nrel.gov

DOE Technology Development Manager: Patrick Davis
Phone: (202) 586-8061; Fax: (202) 586-9811; E-mail: Patrick.Davis@ee.doe.gov

Subcontractors:
American National Standards Institute, New York, NY
American Society of Mechanical Engineers, New York, NY
Compressed Gas Association, Chantilly, VA
CSA America, Inc., Cleveland, OH
International Code Council, Country Club Hills, IL
National Fire Protection Association, Quincy, MA
National Hydrogen Association, Washington, DC
Underwriters Laboratories, Northbrook, IL
Vista, Inc., Clementon, NJ
Kelvin Hecht, Avon, CT
Ron I. Sims, Saline, MI

Objectives

- Facilitate creation and adoption of model building codes and equipment standards for hydrogen systems in commercial, residential, and transportation applications.
- Provide technical resources to harmonize development of international standards among the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), and Working Party on Pollution and Energy (GRPE).

Technical Barriers

This project addresses the following technical barriers from the Codes and Standards section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- A. Limited Government Influence on Model Codes
- B. Competition between International Code Council (ICC) and National Fire Protection Association (NFPA)
- C. Limited State Funds for New Codes
- D. Large Number of Local Government Jurisdictions
- E. Officials Training Differences
- F. Limited DOE Role in the Development of ISO Standards
- G. Inadequate Representation by Government and Industry at International Forums
- H. International Competitiveness
- I. Strategic Conflicts between Domestic and International Standards Objectives
- J. Consensus National Agenda on Codes and Standards
- K. Lack of Domestic Industry Support at International Technical Committees

- L. Competitiveness in Copyright of Published Standards
- M. NFPA 55 has not yet been completed, but is currently in progress
- N. Lack of Technical Data to Revise NFPA 55 Standard
- P. Current Large Footprint Requirements for Hydrogen Fueling Stations

Approach

- Support and facilitate the timely and efficient incorporation of hydrogen safety issues into existing and proposed codes and/or standards promulgated by organizations such as the ICC, NFPA, Society of Automotive Engineers (SAE), and ISO.
- Support and encourage technical and operational consistency among and across the codes and standards developed by different organizations.
- Disseminate and share codes and standards development information.
- Identify critical gaps and deficiencies in codes and standards and formulate recommendations for addressing them.
- Familiarize building code officials, fire safety officials, local/state/Federal policymakers, and other strategic stakeholders (e.g., homebuilders, architects, transportation regulators, etc.) with hydrogen technologies and the related codes and standards.
- Implement national template to harmonize standards, codes, and regulations.
- Develop generic licensing agreement for web-based access to standards.
- Develop training modules and conduct workshops with ICC and NFPA.
- Develop unified national agenda and support consistent representation of technical experts from industry and government at key global venues.
- Develop comprehensive research and development (R&D) plan and program for validation of codes and standards.
- Actively seek opportunities to work collaboratively with other DOE programs and non-Federal organizations involved in hydrogen-related codes and standards efforts to streamline codes and standards development and minimize duplication of efforts.

Accomplishments

- Initiated implementation of national template for national standards, codes, and regulations through subcontracts with standards and model code development organizations:
  - American National Standards Institute: electronic access to standards
  - American Society of Mechnical Engineers: containers, piping, pipelines
  - Compressed Gas Association: containers, fuel quality
  - CSA America, Inc.: dispensing systems
  - International Code Council: codes for the built environment
  - National Fire Protection Association: codes for the built environment
  - Underwriters Laboratories: micro fuel cells, sensors
- Incorporated underground cryogenic hydrogen storage and canopy storage of compressed gaseous hydrogen storage in 2004 amendments to 2003 edition of ICC model codes.
- Coordinated implementation of the national template and codes and standards activities by managing the DOE Hydrogen Codes and Standards Coordinating Committee.

- Co-organized workshops on Hydrogen Materials Compatibility and Unintended Hydrogen Release Scenarios with Sandia National Laboratories.
- Prepared draft R&D Roadmap for Hydrogen Safety, Codes and Standards as a member of the Codes and Standards Tech Team for the FreedomCAR and Fuel Partnership.
- Worked with the ICC Ad hoc Committee for Hydrogen Gas and Sandia National Laboratory to establish a technical basis for separation distances for safe bulk storage of hydrogen.
- Obtained agreement with ANSI to create a hydrogen portal on its national standards network and with key standards and model code development organizations to negotiate with ANSI on posting and downloading hydrogen standards and model codes.
- Initiated incubator project with ANSI, standards development organizations (SDOs), and state code officials in NY, MA, CT, and RI and conducted regional roll-out of the hydrogen portal in Albany, NY.
- Prepared *How to Permit a Hydrogen Fueling Facility Handbook* for local code officials—with ICC, NFPA, and Pacific Northwest National Laboratory (PNNL) (under final public review).
- Contracted with the Compressed Gas Association (CGA) and CSA to coordinate activities of ISO/TC197 and IEC/TC105 as U.S. Technical Advisory Group (TAG) Administrators, respectively, of the two technical committees.
- Conducted workshop on hydrogen fuel quality guidelines and specifications and created a working group to prepare a R&D plan for hydrogen fuel quality.
- Contributed to national codes and standards activities as member of:
  - American Society of Mechanical Engineers (ASME) Hydrogen Steering Committee
  - CSA America Technical Advisory Group for on-board gaseous hydrogen container standard
  - California Fuel Cell Partnership Codes and Standards Working Group and Working Group for Emergency Response Guide for Fuel Cell Buses
  - FreedomCAR and Fuel Partnership Codes and Standards Tech Team
  - NFPA Hydrogen Coordination Committee
  - Underwriters Laboratory (UL) Standards Technical Panel 2264 Hydrogen Generators
  - U.S. Fuel Cell Council Codes and Standards Working Group
- Contributed to international codes and standards activities as member of:
  - U.S. Technical Advisory Group for ISO TC197 (Hydrogen Technologies)
  - ISO/TC197 Working Group 11 (hydrogen fueling facility standard)
  - ISO/TC197 Working Group 12 (hydrogen fuel quality specification)
- Created new website for hydrogen and fuel cell codes and standards (www.fuelcellstandards.com)

Future Directions

- Refine overall codes and standards coordination program.
  - Create one-stop technical assistance for hydrogen projects including directory of primary contacts for information and technical assistance create centralized, publicly accessible web-based data center.
  - Negotiate DOE license through ANSI for electronic access to key standards and model codes from primary standard and code development organizations.
- Conduct annual safety, codes, and standards evaluations and status report.
- Initiate comprehensive R&D plan for validation of standards.
- Develop hydrogen safety training packages for local code officials with NFPA and ICC.

- Identify and fund appropriate experts to fully participate in development of international standards and Global Technical Regulations for hydrogen systems.
- Facilitate development of Global Technical Regulations for hydrogen fuel cell vehicles that are harmonized with U.S. Federal Motor Vehicle Safety Standards.
- Facilitate development of harmonized standards for fuel cell power plants.

Introduction

The development and promulgation of codes and standards are essential if hydrogen is to become a significant energy carrier and fuel because codes and standards are critical to establishing a market-receptive environment for commercializing hydrogen-based products and systems. The Hydrogen, Fuel Cells and Infrastructure Technologies (HFCIT) Program of the U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL), with the help of the leading standards and model code development organizations, other national laboratories, and key stakeholders, are developing a coordinated and collaborative government-industry effort to prepare, review, and promulgate the hydrogen codes and standards needed to expedite hydrogen infrastructure development. The focus of this effort is to put in place a coordinated and comprehensive hydrogen codes and standards program at the national and international levels.

Approach

The overall DOE timetable for codes and standards is based on enabling industry to make a decision to commercialize consumer applications of hydrogen technologies by 2015 (Figure 1). The table provides examples of the R&D that must be conducted and the codes, standards, and regulations that must be in placed if this decision is to be made. For the period from 2003 to 2007, the key activities are R&D to establish a sound scientific and technical basis for requirements incorporated in standards and codes and the development of standards and codes for hydrogen components and systems. The period from 2007 to 2008 should see a transition from R&D and standards and codes development to the formulation of regulations. The period 2008 to 2015 will be focused on establishing a regulatory regime for both domestic consumers and for international trade.

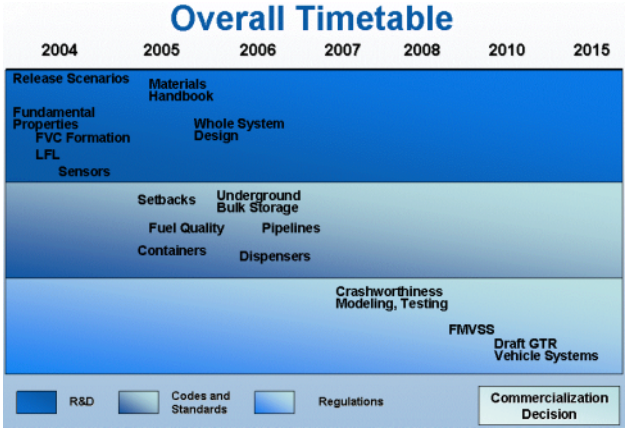

Figure 1. Overall Timetable for R&D, Standards, Codes, and Regulations

DOE and NREL are also working with ANSI to improve access to hydrogen codes and standards. Under a subcontract with NREL, ANSI will develop a portal on its National Resource for Global Standards (NSSN) for hydrogen codes and standards. The portal as presently envisioned will enable selected state and local code officials to download key hydrogen standards and codes. Creation of the portal is part of an outreach and education effort that includes curriculum development and training in conjunction with the continuing education programs of the ICC and the NFPA.

Results

In late FY 2003, DOE and NREL began to implement the templates through subcontracts with the designated lead standards and model code development organizations. Figure 2 shows the organizations, the standards and codes being developed, and the anticipated timetable for this development.

Key results in FY 2004 include adoption of provisions to allow underground cryogenic bulk storage of hydrogen and canopy-top storage of bulk

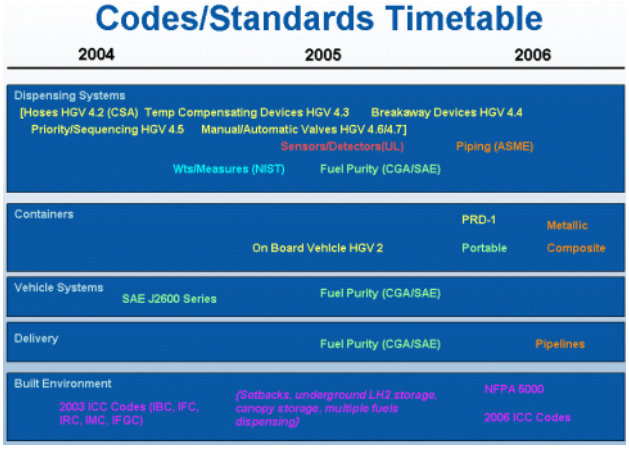

Figure 2. Timetable for Codes and Standards

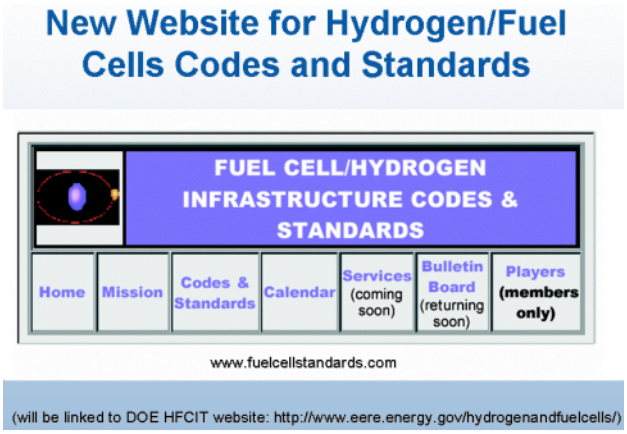

Figure 3. Website for Hydrogen and Fuel Cell Standards

gaseous hydrogen in the 2004 amendments to the 2003 edition of the ICC model codes. With those changes adopted, provisions for the safe use of hydrogen are now incorporated in the ICC's International Building, Residential, Fire, Mechanical, and Fuel Gas Codes. Additional work to reduce the footprint of hydrogen fueling stations (Barrier P) will be considered, and if successful, will be incorporated in the 2006 edition of the ICC model codes.

An important part of implementing the national template is to maintain an awareness of the status and changes in code and standards. To this end, DOE and NREL maintain a matrix (posted at www.hydrogensafety.info) that lists codes and standards by application area and for each code and standard listed provides a brief description, technical contacts, and current status. In February 2004, DOE and NREL created an interactive website (www.fuelcellstandards.com) that allows searching for information on codes and standards under several search criteria, including application and geographic region. The website also tracks activities in codes and standards and will eventually provide a one-stop site for information on codes and standards. Figure 3 shows the home page of the new website.

Key results in international codes and standards include increased activity coordinated by DOE and NREL on hydrogen fuel quality in response to a proposed revision of an ISO standard. DOE and NREL are working with the U.S. Fuel Cell Council, SAE, and other stakeholders to develop a long-term R&D plan to develop test protocols, testing plans, and funding requirements needed to obtain the data for defining hydrogen fuel quality specifications. In FY 2004 there was also progress in strengthening of the collaboration among DOE, DOT, and EPA in representing the interests of the U.S. government and industry at the GRPE. DOE and NREL are members of the U.S. Technical Advisory Group to ISO TC197 and are also members of several ISO TC197 working groups that are developing international hydrogen standards.

Conclusions

In FY2004, DOE and NREL began to implement the national templates for hydrogen codes and standards. Almost all of the key standards and model code development organizations are now engaged in implementing the national templates by developing the standards and model codes that the hydrogen and fuel cell industry and other stakeholders have identified as essential for the commercial application of hydrogen technologies. DOE and NREL also made significant progress in coordinating participation of industry experts in forums involved in developing international standards.

FY 2004 Publications/Presentations

1. Presentation on codes and standards at the initial meeting of the DOE Hydrogen Safety Panel, December 2003.

2. Presentations to FreedomCAR-Fuel Partnership Codes and Standards Tech Team, January and February 2004.

3. Presentation and paper on codes and standards R&D at NHA annual meeting, April 2004.

4. Presentation and paper on codes and standard and poster on sensor development at DOE HFCIT Merit Review, May 2004.

5. Presentation on status of DOE hydrogen safety, codes and standards program at WHEC 15, June 2004.